Subject: Driver Center to Center Spacing for Line Arrays
Posted by Jim Griffin on Fri, 06 Aug 2004 21:46:53 GMT
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I wanted to start a new thread on line array driver spacing versus adding on to DSM's posting on side by side placement. I made a challenge to Bill Fitzmaurice's comments on another forum. See this thread and page down to read all replies: http://www.diyaudio.com/forums/showthread.php?s=&threadid=38560Since I wrote my response on that thread I have condensed and summarized my thoughts on this driver to driver spacing. References to important JBL and L-acoustics papers are also available on the web as I discuss below:Driver to Driver Spacing in Line Arrays The driver to driver spacing concerns associated with line arrays composed of cone and dome drivers are well documented in the literature. The goal of the various researchers who have done this work is to create a coherent wavefront that radiates from the vertical axis in the array. Two companies present exceptional AES technical papers that document how they deal with this issue. Two references stand out in my search: 1. JBL Professional's line array technology reference (John Eargle, David Scheirman, and Mark Ureda paper entitled "JBL's Vertical Technology: Achieving Optimum Line Array Performance Through Predictive Analysis, Unique Acoustic Elements and a New Loudspeaker System" presented at the September 2000 Audio Engineering Society Convention) discusses line array spacing and basic line array performance based upon far field arguments. This paper is available on the web at:http://www.jblpro.com/vertec1/VerTec%20WP%202.3.pdf The JBL authors show the reduction of directivity when operation beyond one wavelength center-to-center spacing between elements in an array is attempted. They also illustrate how the off-axis vertical lobing (comb lines) increase as spacing exceeds one wavelength between acoustic centers. 2. The latest paper which documents more than 12 years of L-Acoustics' line array research is their "Wavefront Sculpture Technology" by Marcel Urban, Christian Heil, and Paul Bauman is in the Journal Audio Engineering Society, Vol. 51, No. 10, 2003 October and can be downloaded via:http://www.l-acoustics.com/pdfproda/wavefront.zip Much of this work details a novel Fresnel analysis technique that promotes understanding of their wavefront sculpture technology (WST) criteria. The WST criteria allow a discrete element line array to assimilate a continuous line source, i.e., radiate a constant phase front. Their conclusion is that the distance between acoustic centers of individual sources should be limited to less than a half wavelength. Other companies who produce line arrays for pro sound applications talk to how they attempt finesse the center-to-center spacing at higher frequencies via the usage of an acoustical waveguide (that is L-acoustics and several other companies solution) or circular throats to transform a set of compression drivers into a slot radiator. Several companies use flat diaphragm or ribbon radiators to address the high frequency issues associated with arrays of cone and dome drivers.My white paper on Near Field Line Array Loudspeakers (see the link below) details more specific tradeoffs on the spacing between drivers. My recommendation for driver spacing criterion is less than one wavelength (at the crossover frequency) distance between the woofers in a two-way array. Generally, cone or dome tweeters can not be located close enough to eliminate comb lines across the entire treble range. My tweeter line preference is to use either planar or ribbon drivers. These drivers typically do not create comb lines as their soundfields do not have sufficient overlap as frequency extends to 20 kHz. Jim
Near Field Line Array White Paper